Vitamin D3 in plants

effect of UVB exposure

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Poster: Vitamin D_3 in plants – effect of UVB exposure

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Introduction: As a surprise for many not only vitamin D_2, but also vitamin D_3 can be found in plants. Vitamin D_3 is formed in the skin of vertebrates by exposure to UVB light (Fig. 1). The synthesis of vitamin D_3 in plants is on the other hand unresolved and contradicting results regarding the dependence of UVB-light has been presented (1,2,3). The aim of this study was, therefore, to investigate vitamin D_3 synthesis and metabolism in plants and how it changes upon UVB-exposure. Most work on vitamin D_3 in plants has been done with non-selective methods such as bioassays, but this study utilizes LC-MS/MS with derivatization to improve sensitivity and selectivity.

Material: Plants were grown in growth chambers with or without UVB light. Three *Solanaceous* species were used: *Solanum glaucophyllum* Desf. (waxy leaf nightshade), *Solanum lycopersicum* L. (tomato) and *Capsicum annuum* L. (pepper).

Method: The leaves were harvested, freeze-dried and saponified over-night. The vitamin D_3 metabolites were extracted from the non-saponified matter followed by solid phase clean-up. Further clean-up was performed with semi-preparative HPLC. Fractions of vitamin D_3, 25-hydroxy vitamin D_3 and 1,25-dihydroxy vitamin D_3 were collected separately and derivatized with 4-Phenyl-1,2,4-triazoline-3,5-dione (PTAD) to increase sensitivity (Fig. 2). The derivatized extracts were subsequently analyzed by LC-ESI-MS/MS. The vitamin D_3 metabolites were quantified using their deuterated form as internal standard.

Results: Vitamin D_3 was identified in *S. glaucophyllum*, *S. lycopersicum* and *C. annuum* (1.7-200 ng/g dry wt.). The vitamin D_3 content in the UVB-exposed plants was 18-64 times higher than for the not UVB-exposed plants. 25-hydroxy vitamin D_3 was only identified in the UVB-exposed plants (0.5-31 ng/g dry wt.), whereas 1,25-dihydroxy vitamin D_3 only was found in UVB-exposed *S. glaucophyllum* (32 ng/g dry wt.).

Conclusion: It is remarkable that the leaves of the *Solanaceous* family contain high amounts of vitamin D_3 bearing in mind that the fruits from, e.g. tomato is an important food for humans. Thus, the potential of plants as a vitamin D_3 source exists. This study demonstrates that both UVB-dependent and independent pathways for biosynthesis of vitamin D_3 exist in plants.

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References

1. Curino, A., Skliar, M., & Boland, R. (1998). Identification of 7-dehydrocholesterol, vitamin D_3, 25(OH)-vitamin D_3 and 1,25$(OH)_2$-vitamin D_3 in *Solanum glaucophyllum* cultures grown in absence of light. *Biochimica et Biophysica Acta*, 1425(3), 485-492.

2. Björn, L. O., & Wang, T. (2001). Is provitamin D a UV-B receptor in plants? *Plant Ecology*, 154(1), 1-8.

3. Boland, R., Skliar, M., Curino, A., & Milanesi, L. (2003). Vitamin D compounds in plants. *Plant Science*, 164, 357-369.